

## CLAIMS

1. A method of making a magnetic head, which has an air bearing surface (ABS) and a back gap (BG), comprising the steps of:
  - 5 forming a second pole tip of a second pole piece with a top surface and a bottom surface at an ABS site for said ABS;
  - 10 the top surface of the second pole tip having a write region located at the ABS site and a stitch region which is recessed from the ABS site toward said back gap;
  - 15 depositing a protective sacrificial layer on the write region of the second pole tip; and
  - 20 forming a second pole piece yoke of a second pole piece magnetically connected to the stitch region of the second pole tip.
2. A method of making a magnetic head as claimed in claim 1 including:
  - 15 said depositing of the sacrificial layer also deposits the sacrificial layer on the stitch region of the second pole tip; and
  - 20 removing said sacrificial layer from the stitch region of the second pole tip.
3. A method of making a magnetic head as claimed in claim 2 wherein the sacrificial layer is alumina.
4. A method of making a magnetic head as claimed in claim 3 including the steps of:
  - 25 forming a first shield layer;
  - 30 forming first and second read gap layers;
  - 35 forming a read sensor between the first and second read gap layers; and
  - 40 forming the first and second read gap layers between the first shield layer and the second pole piece layer.
5. A method of making a magnetic head as claimed in claim 2 including:
  - 35 said depositing of the sacrificial layer also deposits the sacrificial layer over the first write coil layer;

chemically mechanically polishing the sacrificial layer until it is flat, but stopping the chemical mechanical polishing before the top surface of the second pole tip is exposed; and

5 before forming the second pole piece yoke, said removing said sacrificial layer including etching or ion milling the sacrificial layer from the stitch region of the second pole tip until the stitch region is exposed.

6. A method of making a magnetic head as claimed in claim 5 wherein the sacrificial layer is alumina.

10 7. A method of making a magnetic head as claimed in claim 2 including:  
the forming of the second pole tip also forms the second pole tip with a pole tip pedestal in the stitch region;  
said depositing of the sacrificial layer also deposits the sacrificial layer over  
15 the first write coil layer;  
said removing of the sacrificial layer includes chemically mechanically polishing the sacrificial layer until the sacrificial layer is flat and the pole tip pedestal in the stitch region is exposed, but stopping the chemical mechanical polishing before the write region of the second pole tip is exposed; and  
20 the forming of the second pole piece yoke magnetically connects the second pole piece yoke to the second pole tip pedestal.

8. A method of making a magnetic head as claimed in claim 7 including the steps of:

25 forming a first insulation layer directly on the write gap layer with a front portion which is recessed from the ABS toward the back gap but is located under a pedestal site of the second pole tip pedestal; and

30 said forming of the second pole tip forms the second pole tip with said second pole tip pedestal without additional processing steps because of a profile of the front portion of said first insulation layer.

9. A method of making a magnetic head as claimed in claim 8 wherein the sacrificial layer is alumina.

10. A method of making a magnetic head as claimed in claim 2 wherein 5 after forming the first pole piece layer the method includes the steps of:

depositing a first alumina layer;

chemically mechanically polishing the first alumina layer;

said forming of the first write coil forming the first write coil on the first alumina layer after chemical mechanical polishing the first alumina layer;

10 removing a first portion of the first alumina layer to expose a stitch region of the first pole piece layer which is located at said ABS site and between the ABS site and the back gap and removing a second portion of the first alumina layer at the back gap exposing a back gap region of the first pole piece;

15 forming a first pedestal of the first pole piece connected to the stitch region of the first pole piece layer and forming a second pedestal of the first pole piece connected to the back gap region of the first pole piece layer;

said forming of the write gap layer forming the write gap layer on a top of the first pedestal of the first pole piece and on a top surface of the second pedestal of the first pole piece;

20 said forming of the second pole tip forms the second pole tip on the write gap layer above the first pedestal of the first pole piece;

forming a second write coil layer on the write gap layer between the second pole tip and the back gap; and

25 said depositing of the sacrificial layer also deposits the sacrificial layer on top of the second write coil layer.

11. A method of making a magnetic head as claimed in claim 10 including:

30 said depositing of the sacrificial layer also deposits the sacrificial layer over the first write coil layer;

chemically mechanically polishing the sacrificial layer until it is flat, but stopping the chemical mechanical polishing before the top surface of the second pole tip is exposed; and

5 before forming the second pole piece yoke, said removing said sacrificial layer including etching or ion milling the sacrificial layer from the stitch region of the second pole tip until the stitch region is exposed.

12. A method of making a magnetic head as claimed in claim 11 including:

10 forming the second pole piece with a back gap pedestal at the back gap and magnetically connecting the back gap pedestal to the second pedestal of the first pole piece;

15 the forming of the back gap pedestal also forming the back gap pedestal with a top surface which is coplanar with the top surface of the second pole tip;

15 said chemical mechanical polishing of the sacrificial layer also exposing the top surface of the back gap pedestal; and

20 said forming of the second pole piece yoke also magnetically connecting the second pole piece yoke to the exposed top surface of the back gap pedestal.

20 13. A method of making a magnetic head as claimed in claim 12 wherein the sacrificial layer is alumina.

14. A method of making a magnetic head as claimed in claim 13 including the steps of:

25 forming a first shield layer;

forming first and second read gap layers;

forming a read sensor between the first and second read gap layers; and

25 forming the first and second read gap layers between the first shield layer and the second pole piece layer.

15. A method of making a magnetic head as claimed in claim 10 including:  
the forming of the second pole tip also forms the second pole tip with a pole  
tip pedestal in the stitch region;

5 said depositing of the sacrificial layer also deposits the sacrificial layer over  
the first write coil layer;

said removing of the sacrificial layer includes chemically mechanically  
polishing the sacrificial layer until the sacrificial layer is flat and the pole tip pedestal  
in the stitch region is exposed, but stopping the chemical mechanical polishing before  
the write region of the second pole tip is exposed; and

10 the forming of the second pole piece yoke magnetically connects the second  
pole piece yoke to the second pole tip pedestal.

16. A method of making a magnetic head as claimed in claim 15 including:  
15 forming the second pole piece with a back gap pedestal at the back gap and  
magnetically connecting the back gap pedestal to the second pedestal of the first pole  
piece;

the forming of the back gap pedestal also forming the back gap pedestal with a  
top surface which is coplanar with the top surface of the second pole tip pedestal;

20 said chemical mechanical polishing of the sacrificial layer also exposing the  
top surface of the back gap pedestal; and

said forming of the second pole piece yoke also magnetically connecting the  
second pole piece yoke to the exposed top surface of the back gap pedestal.

17. A method of making a magnetic head as claimed in claim 16 including  
25 the steps of:

forming a first insulation layer directly on the write gap layer with a front  
portion which is recessed from the ABS toward the back gap but is located under a  
pedestal site of the second pole tip pedestal; and

30 said forming of the second pole tip forms the second pole tip with said second  
pole tip pedestal without additional processing steps because of a profile of the front  
portion of said insulation layer.

18. A method of making a magnetic head as claimed in claim 17 wherein the sacrificial layer is alumina.

19. A method of making a magnetic head as claimed in claim 18 including  
5 the steps of:  
forming a first shield layer;  
forming first and second read gap layers;  
forming a read sensor between the first and second read gap layers; and  
forming the first and second read gap layers between the first shield layer and  
10 the second pole piece layer.

20. A method of making a magnetic head as claimed in claim 16 wherein  
after chemically mechanically polishing the sacrificial layer to expose the second pole  
tip pedestal and expose the back gap pedestal, forming a second insulation layer over  
15 the second write coil layer between the pole tip pedestal and the back gap pedestal.

21. A method of making a magnetic head as claimed in claim 20 wherein  
the sacrificial layer is alumina.

20 22. A method of making a magnetic head as claimed in claim 21 including  
the steps of:  
forming a first shield layer;  
forming first and second read gap layers;  
forming a read sensor between the first and second read gap layers; and  
25 forming the first and second read gap layers between the first shield layer and  
the second pole piece layer.

23. A method of making a magnetic head as claimed in claim 1 including  
the steps of:

30 forming a first pole piece layer of a first pole piece;  
forming a nonmagnetic write gap layer on the first pole piece layer;

forming a first write coil layer on the write gap layer; and  
the forming of the second pole tip forming the bottom surface of the second  
pole tip on the write gap layer.

5        24.    A method of making a magnetic head as claimed in claim 23  
including:

      said depositing of the sacrificial layer also deposits the sacrificial layer on the  
stitch region of the second pole tip; and

      removing said sacrificial layer from the stitch region of the second pole tip.

10       25.    A method of making a magnetic head as claimed in claim 24 including:

      said depositing of the sacrificial layer also deposits the sacrificial layer over  
the first write coil layer;

15       stopping the chemical mechanical polishing before the top surface of the second pole  
tip is exposed; and

      before forming the second pole piece yoke, said removing said sacrificial  
layer including etching or ion milling the sacrificial layer from the stitch region of the  
second pole tip until the stitch region is exposed.

20       26.    A method of making a magnetic head as claimed in claim 25 including  
the step of forming an inset insulation layer inset in the first pole piece layer between  
the ABS and the first write coil layer for defining a zero throat height of the head.

25       — 27.    A method of making a magnetic head as claimed in claim 26 wherein  
the sacrificial layer is alumina.

28.    A method of making a magnetic head as claimed in claim 25 including:  
the forming of the second pole tip also forms the second pole tip with a pole  
30       tip pedestal in the stitch region;

5 said depositing of the sacrificial layer also deposits the sacrificial layer over the first write coil layer;

10 said removing of the sacrificial layer includes chemically mechanically polishing the sacrificial layer until the sacrificial layer is flat and the pole tip pedestal in the stitch region is exposed, but stopping the chemical mechanical polishing before the write region of the second pole tip is exposed; and

15 the forming of the second pole piece yoke magnetically connects the second pole piece yoke to the second pole tip pedestal.

20 29. A method of making a magnetic head as claimed in claim 28 including the step of forming a ZTH defining insulation on the first pole piece layer entirely between the ABS and the first write coil layer for defining a zero throat height (ZTH) of the head.

15 30. A method of making a magnetic head as claimed in claim 29 wherein the sacrificial layer is alumina.

20 31. A magnetic head that has an air bearing surface (ABS) and a back gap, comprising:

25 a first pole piece including:

a first pole piece layer;

a first pedestal located at the ABS and magnetically connected to the first pole piece layer and a second pedestal located at the back gap and magnetically connected to the first pole piece layer with the first and second pedestals spaced from each other;

25 a first write coil located in the space between the first and second pedestals;

a write gap layer on a top of the first pedestal;

a second pole piece including:

1 a second pole tip located at the ABS on the write gap layer, and  
a back gap pedestal spaced from the second pole tip and magnetically  
connected to the second pedestal of the first pole piece;

5 a second write coil layer located in the space between the  
second pole tip and the back gap pedestal; and

a second pole piece yoke magnetically connected to each of the  
second pole tip and the back gap pedestal and located over the second  
write coil layer.

10 32. A magnetic head as claimed in claim 31 including:

a top surface of the second pole tip having a write region located at the ABS  
and a stitch region which is recessed in the head;

the second pole piece yoke being magnetically connected to the second pole  
tip at said stitch region; and

15 a sacrificial layer covering the write region of the second pole tip.

33. A magnetic head as claimed in claim 32 wherein the sacrificial layer is  
also located between the second write coil layer and the second pole piece yoke.

20 34. A magnetic head as claimed in claim 33 including:

a first shield layer;

first and second read gap layers;

a read sensor located between the first and second read gap layers; and

25 the first and second read gap layers being located between the first shield  
layer and the first pole piece layer.

35. A magnetic head as claimed in claim 34 wherein the sacrificial layer is  
alumina.

36. A magnetic head as claimed in claim 33 including:  
the second pole tip having a second pole tip pedestal at its stitch region; and  
the second pole piece yoke being directly magnetically connected to the  
second pole tip pedestal.

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37. A magnetic head as claimed in claim 36 including:  
a first shield layer;  
first and second read gap layers;  
a read sensor located between the first and second read gap layers; and  
10 the first and second read gap layers being located between the first shield  
layer and the first pole piece layer.

38. A magnetic head as claimed in claim 37 wherein the sacrificial layer is  
alumina.

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39. A magnetic disk drive, having at least one magnetic head assembly that  
has a write head, a read head and an air bearing surface (ABS), comprising:  
the write head including:

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a first pole piece including:  
a first pole piece layer;  
a first pedestal located at the ABS and magnetically connected  
to the first pole piece layer and a second pedestal located at the back  
gap and magnetically connected to the first pole piece layer with the  
first and second pedestals spaced from each other;

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a first write coil located in the space between the first and  
second pedestals;

a write gap layer on a top of the first pedestal and on a top of  
the first write coil;

a second pole piece including:

a second pole tip located at the ABS on the write gap layer, and a back gap pedestal magnetically connected to the second pedestal of the first pole piece; and

5 a second pole piece yoke magnetically connected to each of the second pole tip and the back gap pedestal; and

the read head including:

a sensor;

nonmagnetic nonconductive first and second read gap layers;

the sensor being located between the first and second read gap layers;

10 a ferromagnetic first shield layer; and

the first and second read gap layers being located between the first shield layer and the first pole piece layer; and

a housing;

a magnetic disk rotatably supported in the housing;

15 a support mounted in the housing for supporting the magnetic head assembly with said ABS facing the magnetic disk so that the magnetic head is in a transducing relationship with the magnetic disk;

a spindle motor for rotating the magnetic disk;

20 an actuator positioning means connected to the support for moving the magnetic head to multiple positions with respect to said magnetic disk; and

a processor connected to the magnetic head, to the spindle motor and to the actuator for exchanging signals with the magnetic head, for controlling movement of the magnetic disk and for controlling the position of the magnetic head.

25 40. A magnetic disk drive as claimed in claim 39 including:

a top surface of the second pole tip having a write region located at the ABS and a stitch region which is recessed in the head;

the second pole piece yoke being magnetically connected to the second pole tip at said stitch region; and

30 a sacrificial layer covering the write region of the second pole tip.

41. A magnetic disk drive as claimed in claim 40 wherein the sacrificial layer is also located between the second write coil layer and the second pole piece yoke.

5 42. A magnetic disk drive as claimed in claim 41 wherein the sacrificial layer is alumina.

10 43. A magnetic disk drive as claimed in claim 41 including:  
the second pole tip having a second pole tip pedestal at its stitch region; and  
the second pole piece yoke being directly magnetically connected to the second pole tip pedestal.

15 44. A magnetic disk drive as claimed in claim 43 wherein the sacrificial layer is alumina.

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